DIAGNOSTIC PROCEDURES FOR THE ROYAL AUSTRALIAN NAVY SIDE SCAN SONAR DISPLAY

AR-008-240

B. C. PAMIAS AND R. A. NEILL

MRL-TN-629

SEPTEMBER 1993

APPROVED

FOR PUBLIC RELEASE

C Commonwealth of Australia

MATERIALS RESEARCH LABORATORY

DSTO

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF COLOR PAGES WHICH DO NOT REPRODUCE LEGIBLY ON BLACK AND WHITE MICROFICHE.

Contents

Diagnostic Procedures for the Royal Australian Navy Side Scan Sonar Display

B.C. Pamias and R.A. Neill

MRL Technical Note
MRL-TN-629

Abstract

The report describes bench testing and fault finding methodologies and instrumentation which are intended for use with the sonar data acquisition and display component of the Royal Australian Navy route surveillance system. The proposed techniques are to be used operationally at the organisational and intermediate levels. Test hardware is described which provides acceptable test signals for the evaluation and fault finding analysis of the Info Express Sonar Imaging and Data Acquisition (SIDA) system and, in part, the Klein 595 Side Scan Sonar units, including all associated A/D converters. This equipment has been used successfully in locating a previously unsuspected fault in one SIDA unit. A recommendation is made that standards be established against which the performance of the SIDA unit's digitisers can be assessed.

DEPARTMENT OF DEFENCE
DSTO MATERIALS RESEARCH LABORATORY

94 T 21 174

Diagnostic Procedures for the Royal Australian Navy Side Scan Sonar Display

1. Introduction

The Royal Australian Navy is currently developing a route surveillance system (RSS) which utilises side scan sonar as its primary data gathering tool. As the equipment required to perform the sonar imaging is relatively complex, major repair and overhaul will be conducted on a maintenance contract basis. Much of the responsibility for day-to-day, operational maintenance of the equipment, however, will fall to naval personnel. It is therefore important that fault finding procedures be clearly defined. The Navy, through the Minesweeping Project, is currently working towards the development of a standard set of diagnostic and fault finding procedures for use with the RSS. The following report describes the design and method of application of an instrument which can potentially be used to perform some of the diagnostic tests of the route surveillance system.

The sonar data acquisition component of the RSS currently comprises four major subsystem components; a towed body; a towing mechanism comprising a cable, winch and interconnections; a sonar control unit (currently a KLEIN 595); and a display unit (Info Express Sonar Imaging and Data Acquisition System (SIDA)). The display unit digitises the sonar signals, conditions the digitised information and presents it on a display monitor. This report details methods and instrumentation which can be used to confirm that the sonar data acquisition and display components of the SIDA are fully functional and correctly calibrated. Faults can occur in any one of the above subsystems, or in their interconnections, and produce ambiguous symptoms on the display screen. Techniques are also described which can be used to isolate faults which have occurred in the fourth subsystem (the SIDA) or its sonar interconnections. It should be noted that techniques described in this report are directed towards the evaluation and fault finding of the data acquisition and data display components of the SIDA. Guidance on the troubleshooting and maintenance of the computing hardware and software associated with the SIDA is given in the Operations Guide for that device [1].

2. *Functional Description of the SIDA*

Side scan sonar signals typically occur in two stages. The first stage, following transmission of the acoustic pulse into the water, is a period of low acoustic return and is known as the "water column". This corresponds to the time required for the acoustic signal to reach the point on the sea bed which is closest to the transducer array (generally almost directly below the towed body), be reflected and return to the receiver. The second stage begins from the time the first sea bed return is received. As horizontal range across the sea floor increases, so does the two-way transmission time for the pulse. Thus by plotting signal strength against transmission time it is possible to generate an "image" of the sea bed. If the altitude of the towed body, measured relative to the sea bed, is known and if it is assumed that the sea bed is relatively flat, then it is possible to convert transmission time to horizontal range. This is known as slant range correction. It should be noted that sonar returns are actually being received from all points on a cylindrical wavefront. In order for slant range correction to be valid it is necessary to assume (a) that the return from all parts of the wavefront, other than that reflected from the sea bed, is negligible, and (b) that the speed of sound in water is constant. While neither assumption is strictly valid, in most instances the errors which result from their adoption are not great. As the sonar returns from the sea bed are greatest at close horizontal ranges, under most conditions the transition from water column to sea bed return is quite sharp. By tracking this transition it is possible to monitor the altitude of the towed body and thus to perform a slant range correction on returning sonar signals. The SIDA system is designed to separate the returning signals into the two side scan sonar stages.

Figure 1 is a functional block diagram of the sonar data acquisition and display modules of the SIDA. The output of the side scan sonar unit is interfaced to the SIDA through five ports in the sonar data acquisition module (DAM). The sonar unit notifies the start of each ping by outputting a trigger pulse. The SIDA has a functional sub-module dedicated to the detection of this trigger pulse. The other outputs of the sonar represent the raw sonar data for port and starboard transducers at 100 kHz and at 500 kHz. A functional sub-module digitally samples each of these signals at a constant rate, then applies a bottom detection algorithm to the data. When the bottom is detected, a further series of digitisers begins acquisition of the data for each of the sonar channels. Unlike the bottom tracking digitisers, the sampling intervals for these digitisers are not fixed, but are varied according to a slant range correction table. Thus the signals are sampled in terms of units of distance across the bottom. In a typical operational mode the total horizontal range, per side, is 100 m and there are 1024 equi-spaced samples across that range.

Once signals have been sampled and digitised, the data are transmitted along an external data bus to a pair of image processing and video display (IPVD) modules, one module for each sonar frequency. Both slant range corrected (2048 samples per ping) and fixed interval (1024 samples per ping) sampled data are transmitted to these modules. The data are assembled ready for display, and output, via a selector switch, to the display. Only one sonar frequency can be displayed at any time.
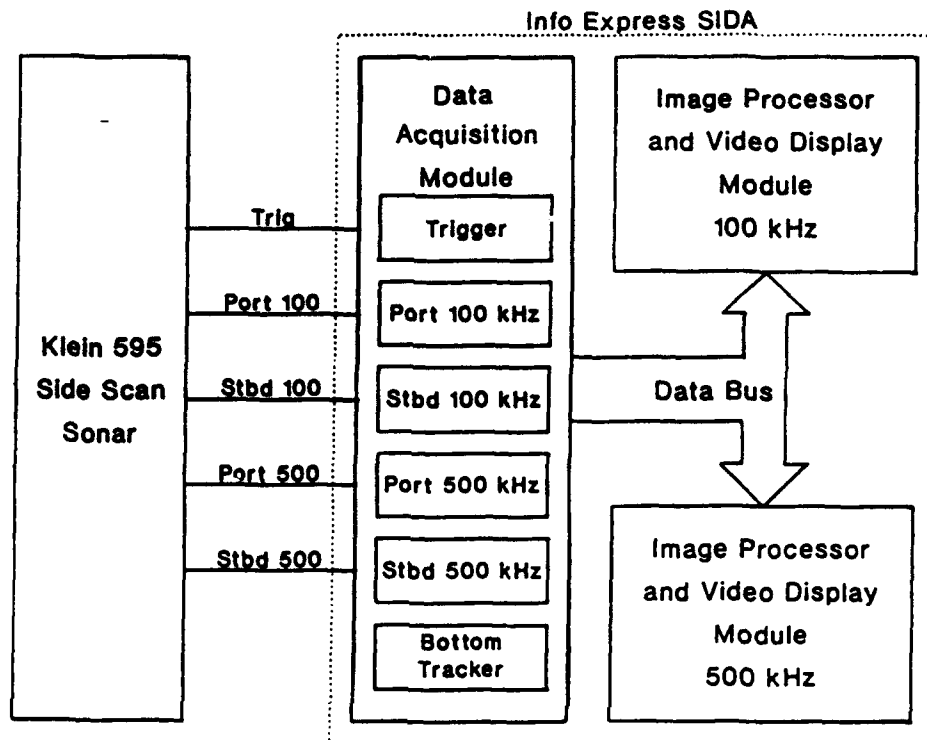
```
┌─────────────┐     ┌──────────────────┐   ┌──────────────────┐
│             │     │      Data        │   │  Image Processor │
│    -        │     │   Acquisition    │   │  and Video Display│
│             │     │     Module       │   │      Module      │
│             │ Trig│   ┌──────────┐   │   │     100 kHz      │
│             │─────┤   │ Trigger  │   │   └──────────────────┘
│             │     │   └──────────┘   │            ▲
│             │Port 100 ┌──────────┐   │            │
│ Klein 595   │─────┤   │Port 100 kHz│ │            ▽
│ Side Scan   │Stbd 100 ┌──────────┐   │   Data Bus │
│   Sonar     │─────┤   │Stbd 100 kHz│ │            │
│             │     │   └──────────┘   │            │
│             │Port 500 ┌──────────┐   │            │
│             │─────┤   │Port 500 kHz│ │            ▽
│             │     │   └──────────┘   │   ┌──────────────────┐
│             │Stbd 500 ┌──────────┐   │   │  Image Processor │
│             │─────┤   │Stbd 500 kHz│ │   │  and Video Display│
│             │     │   └──────────┘   │   │      Module      │
│             │     │   ┌──────────┐   │   │     500 kHz      │
│             │     │   │  Bottom  │   │   └──────────────────┘
│             │     │   │  Tracker │   │
└─────────────┘     │   └──────────┘   │
                    └──────────────────┘
```

Figure 1: *Functional block diagram of the sonar data acquisition and display modules of the SIDA.*

3. Test Methodologies

3.1 Bench Testing of SIDA

The procedures which are proposed in this section can be used to confirm that the sonar data acquisition and display functions of the SIDA are fully functional. Several factors were considered in devising these procedures. There was no specific requirement that procedures or test instrumentation should be useful in locating faults at the component level; that is the job of the maintenance contractors. In the event of problems arising, however, it was a requirement that the technician should be able to provide the maintenance engineer with sufficient information to allow the likely faulty module or modules to be isolated. It was assumed that test personnel would be competent technicians but not necessarily engineers or scientists. Optional features were therefore kept to a minimum. It was assumed that basic test instrumentation, such as digital voltmeters, would be available to the technician. Finally, it was decided that test procedures should be

designed so that the performance of the subsystem under test, the SIDA, can be evaluated in isolation from other subsystems of the RSS.

The test sequences discussed in this section are based on the application of a Diagnostic Signal Generator (DSG), a detailed description of which is included below, which was designed and the prototype built and tested at the Materials Research Laboratory (MRL). The instrument was originally developed as a scientific tool for use by MRL staff in the assessment of the performance of the SIDA. -The DSG has a trigger output and separate port/starboard outputs at both sonar frequencies. Thus, referring to Figure 1, the DSG was designed to be substituted for the Klein 595 sonar unit. The DSG generates a trigger pulse whose characteristics are matched to those of the Klein unit's trigger. The other, "sonar" outputs of the DSG can be switched between two modes. The first mode is intended to be used for confirmation of normal function of the SIDA, and for tracing apparent faults through the system. It is intended that the second mode be used in checking that all of the data acquisition sub-modules are correctly calibrated.

In its first operating mode the DSG unit generates a repeatable signal with a two-stage characteristic similar to side scan sonar operating at a range of 100 m. This signal, being distinctive and repeatable, can be traced through the SIDA during fault-finding operations. An output timing diagram is illustrated in Figure 2. It can be seen that the "sonar" output of the DSG is a modified ramp waveform. The low-level signal following the trigger simulates a water column. The duration of this portion of the waveform is set at 13.3 ms, corresponding to a towfish altitude of 10 m. The waveform then rises rapidly to maximum output voltage. In an actual sonar recording this would correspond to the receipt of the bottom-reflected signal from directly below the towfish. This feature is designed to provide a test of the bottom-tracking circuitry of the SIDA. The slow downward ramp covers the full dynamic range of the analogue-to-digital converters in the DAM module. Finally, a steady-state, low-level portion of the waveform can be used to check for the absence of noise or jitter in the SIDA.

The DSG unit is connected to all five sonar input lines of the SIDA. The SIDA should then be initialised and set to realtime data acquisition mode with a range of 100 m. In normal operation, amplitude ramps should be presented in all three display fields of the SIDA, as shown in Figure 3. The port and starboard slant range corrected fields, at left and centre of the display screen respectively, should have the low-level "water column" removed. They should show a large amplitude signal close to the midline, with a progressive reduction of amplitude as the slant range increases. The bottom-tracking display field, at the right of the screen, should present the low-level signal of the "water column" and part of the ramping signal, for both port and starboard sides. The system status display should indicate that the towfish altitude is 10 m. In the event of an abnormal display occurring, Table 1 details the characteristic displays for several possible faults.

Table 1: SIDA operating characteristics for a number of possible fault conditions

| SYMPTOM	POSSIBLE CAUSE
Normal display, both frequencies	System operating normally
No scrolling display at either frequency, DAM status LEDs not blinking, record number on DAM status display not incrementing	Trigger sub-module faulty. Trigger cable faulty
No scrolling display at either frequency, DAM status LEDs blinking, record number on DAM status display incrementing	Data bus faulty (run SIDA diagnostic software) Display monitor switched off / faulty
Scrolling display, one frequency only	Relevant IPWD module non-functional
Water column visible in slant range display fields, towfish altitude shown as significantly different from 10 m	Bottom-tracking sub-module not functioning correctly
No valid data for one specific sonar frequency and side in slant range display field	Suspect analogue-to-digital converter sub-module for that frequency and side
No valid data for one specific sonar frequency and side in water column display field	Suspect analogue-to-digital converter in bottom-tracking sub-module for that frequency and side
No valid data for one specific sonar frequency and side in both slant range and bottom-tracking display fields	Suspect cables and connections for that frequency and side
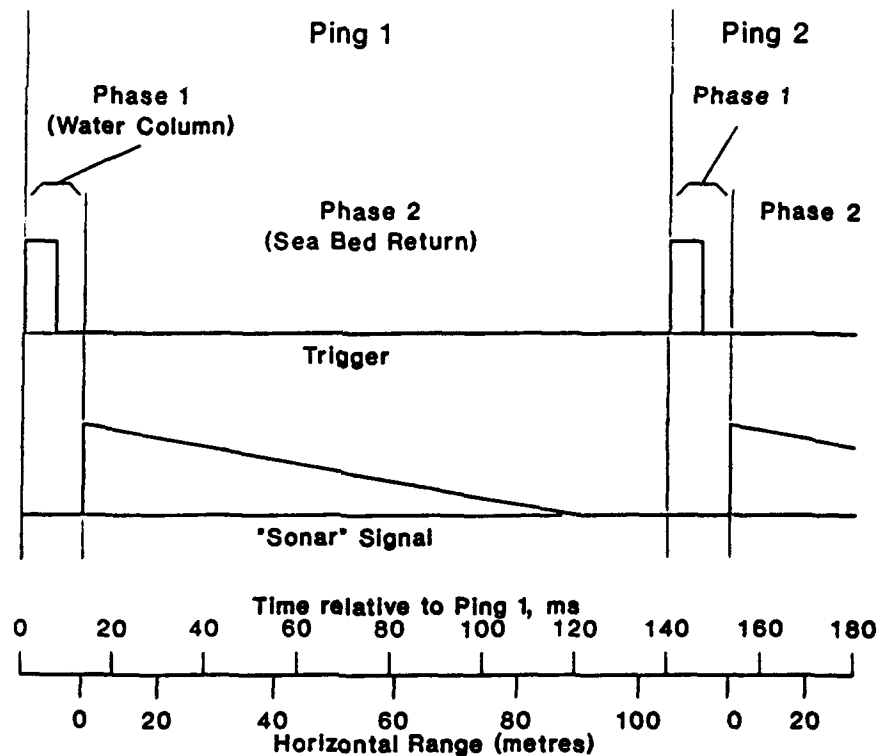
Figure 2: Output timing diagram of the Diagnostic Signal Generator. The "sonar" output of the DSG is a modified ramp waveform, designed to simulate the two-stage characteristics of side scan sonar.
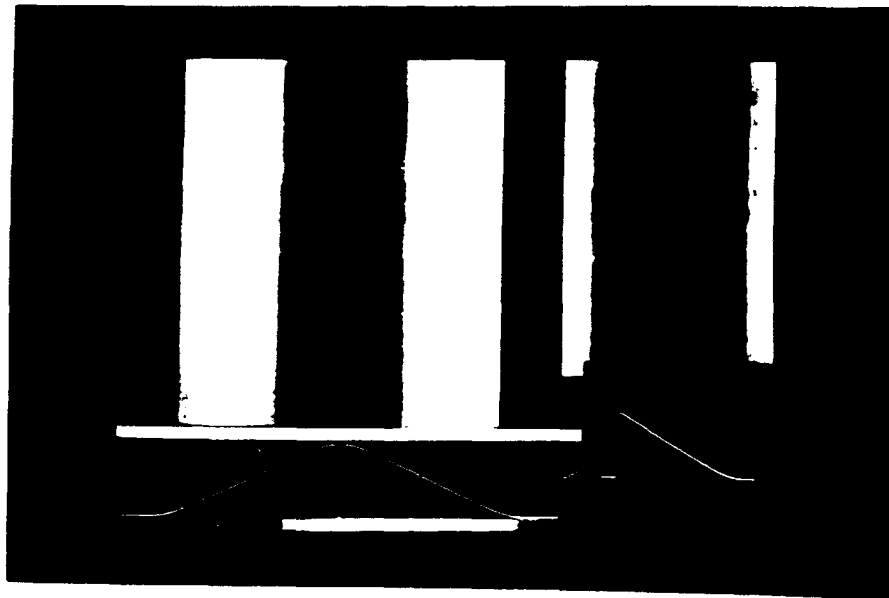
Figure 3: Photograph of a SIDA display representation of an acquired DSG sonar signal. Black and Red represent high amplitude signals. Blue represents low signal strength. The mirror at the bottom right of the screen, which obscures an optional "zoom window", shows a reflected image of an oscilloscope trace of the input signal. The trace shows a low-level signal ("water column") followed by a rapid rise (water column/sea bed interface) and then a linear, downward signal ramp. The SIDA display is functionally divided according to the following description. The output of the bottom tracker is displayed as a composite of port and starboard sides across one third of the screen width, at top right. The "ship's track" is up the centre of the water column, represented by a low-level signal shown in blue. Lateral displacement from this midline is a representation of the two-way transmission time of a signal. Thus, with this signal, a correctly calibrated SIDA system should produce mirror-imaged port and starboard records. The rapid signal strength transition at the water column/sea bed interface is represented on the screen by a colour change from blue to black. As the bottom tracker samples at a fixed rate and the input ramp is linear, the colour bands on either side of the water column should all be the same width. Port and starboard side slant range corrected data are presented at the top of the screen, at left and centre respectively, with the water column removed. In this case a lateral displacement on the screen is a representation of linear distance across the sea bed. Once again port and starboard sides should be mirror images of each other. The waveform displays at lower left and centre of the screen represent the digitised, slant range corrected record of a single ping. Note that the slant range correction gives the ramping waveform a curved appearance, a fact which can also be deduced from the non-uniform widths of the coloured amplitude bands.

By selecting the second operating mode of the DSG, it is possible to confirm that the analogue-to-digital converters in the DAM module are operating within particular specified tolerances of amplitude and linearity. At the time of writing of this report, no such standards have been established by the Navy [2]. In order to facilitate the direct comparison of data recorded from different SIDA units it is strongly recommended that this be done. Facilities exist for the connection, in parallel with the SIDA unit, of a three-digit multimeter to the sonar outputs of the DSG. In addition to the trigger signal, in this mode the DSG simply outputs an adjustable, DC voltage. The recommended procedure is to select the waveform display on the SIDA and, starting with the DSG output voltage at 0 V, to progressively increase the DSG voltage through the full dynamic range of the SIDA digitisers. By stepping the DSG voltage through, say, 20 output voltage levels and taking a note of the digitised level for both bottom-tracking and slant range input sub-modules at each sonar frequency and side, it is possible to prepare a calibration graph for all eight digitisers. The digitised values should all fall within specified bounds before the SIDA is allowed to be used to collect sonar data. It is recommended that standards be set and that this calibration check be performed on an annual basis, or after major repairs have been performed on the system.

The DSG unit can also be used to confirm correct operation of the analogue-to-digital converters, bottom-tracking/slant range correction circuitry and chart recorder of the Klein sonar. The DSG is connected to the "tape in" port of the sonar, and operated as for the SIDA. In normal operation, amplitude ramps should be printed on each of the print fields of the chart recorder. It should be noted that, while the "rub test", described below, can also be used to bench test the chart recorder, it does not check the sonar's bottom-tracking circuitry, neither does it yield a time-varying signal which systematically covers the full range of the sonar's signal processing circuitry.

3.2 Fault Finding in the Operational Environment

It is proposed that the procedures described in this section be used in the operational environment to trace faults which are suspected to involve the sonar data acquisition and display functions of the SIDA, or the subsystem interconnections. It is expected that the tests would be performed by the ship's electrician.

The sequence of tests to be performed is illustrated in Figure 4. In the event of an apparent fault developing during operational deployment of the system, as reflected by the absence of one or more channel from the sonar display, the towed body should normally be recovered. Upon recovery, a "rub test" should be performed: with the sonar running, a hand is passed over the surface of the transducer arrays, one side at a time. For both sonar frequencies this should produce a characteristic banding pattern on the relevant side of the SIDA display and sonar chart recorder. If this occurs, with comparable records produced by display and chart, then the system tests satisfactorily and the towfish should be redeployed and retried in the water. If the problem recurs, then the fault is probably in the cable or the towfish connector.
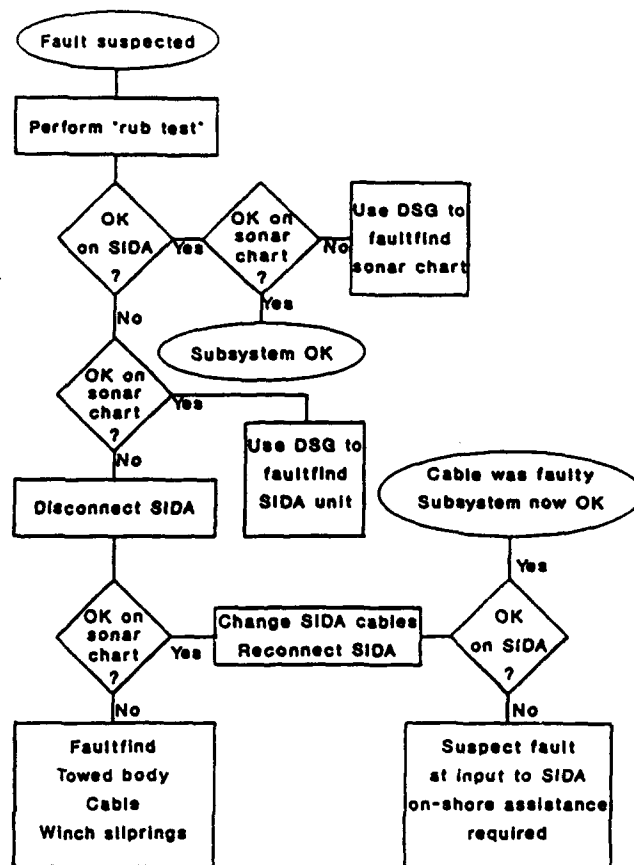
Figure 4: *Illustrating a proposed sequence of tests to be performed in the event of an apparent fault developing during operational deployment of the RSS.*

If the rub test produces apparently normal results on the sonar chart but abnormal results on the SIDA, then the fault could lie in the SIDA itself or in the interconnecting cables leading from the sonar. The DSG unit should then be substituted for the Klein sonar and some data collected using the ramping waveform mode. If the DSG test confirms that there is a fault in the SIDA, then the interconnecting cables should be replaced. If the SIDA still displays abnormal test waveforms, then the problem is internal and the system requires shore-based attention. Alternatively, if the SIDA performs normally the fault was in an interconnecting cable. The sonar can be reconnected, with the new cables, and the rub test repeated.

In the event that both sonar chart and SIDA outputs are abnormal, it would generally be expected that the fault lies in the towfish, cable, winch assembly or the pre-amplification stages of the sonar. Due to a peculiarity in the design of the sonar, however, a short-circuit in an interconnecting cable or at the input to the SIDA unit can also cause abnormal or non-existent chart outputs for individual channels on the Klein unit. It is therefore recommended that the Klein/SIDA interconnecting cable for the non-functional channel be disconnected at the Klein and the rub test repeated. If the chart printout begins to function correctly, then the cable should be replaced and the test repeated. A continuing fault implies that there is a fault at the input to the SIDA, and shore-based attention is required.

4. Detailed Description of Test Instrumentation

4.1 Design Criteria

A set of design criteria were developed, by the authors, against which the performance of the DSG instrument could be assessed. These criteria are based on the functional requirements imposed by the test procedures which have been proposed in the preceding section.

It was required that the instrument should meet the following criteria:

1. It should be possible to use the instrument to confirm correct operation of the SIDA, independent of the side scan sonar unit.

2. The DSG unit must generate a distinctive and repeatable signal which can be traced through the SIDA during fault-finding operations.

3. Used in combination with a 3 digit Digital Volt Meter (DVM), it must be possible to use the unit to confirm the calibration of the analogue-to-digital converters in the SIDA system.

4. It should be possible to use the instrument to confirm correct operation of the analogue-to-digital converter circuits, bottom-tracker and chart recorder of the Klein 595 side scan sonar.

5. The instrument must generate trigger pulses whose characteristics are indistinguishable from those of the Klein side scan sonar.

6. The DSG unit must have an output voltage, either ramping or DC, which can vary from 0 V to an upper limit of 5 V. The voltage limits for the ramping waveform must, however, be internally adjustable. This will allow the DSG to be adjusted to best accommodate future configurations in the sonar equipment.

7. The unit should be sufficiently compact to allow it to be carried as part of a MSA (small) vessel's tool kit.

8. Test units must have low power consumption to allow for reliable battery operation. Alternatively, the unit may be powered externally if a mains supply is available via a mini power supply for the purpose of conserving battery life. To ensure ample time for trouble-shooting work, operational battery life must be at least four hours at maximum load.

9. The test unit must give an appropriate indication that it is fully functional.

10. The unit must incorporate a fail-safe provision to ensure that (a) it cannot be damaged by being connected to a faulty SIDA or sonar unit, and (b) if the DSG itself should fail during use, there is minimal probability that it will cause damage to the SIDA or sonar units.

4.2 Functional Description

The Diagnostic Signal Generator is divided into four functional stages, as summarised below. A detailed description of the hardware implementation of these functional stages is included in Appendix 2.

STAGE 1: Voltage Regulation and Over-Voltage Protection

The voltage regulator stage provides a constant 5.0 V output, which is compatible with the digital electronics used in the DSG. The regulator is configured in a "crowbar" network to provide protection, for instruments to which the DSG is connected, against excessive voltages which could occur in the event of failure of the voltage regulator.

STAGE 2: Square Wave Generator

This stage generates a square wave input to stages 3 and 4. A 140 ms timing period is required at stage 3, for the production of a ramp signal acceptable to the SIDA. Similarly, stage 4 requires the same input to produce a suitable synchronous pulse to drive the SIDA.

STAGE 3: RAMP and ADJUSTABLE DC Generator with visual (LED) indication of operating mode

This stage contains the electronics required for the generation of the required test signals, namely RAMP and ADJUSTABLE DC. Incorporated in this stage is the LED network which provides visual indication of operating mode.

STAGE 4: Synchronous Pulse Generator

This stage provides the synchronous pulses required to drive the Info Express SIDA and KLEIN units, each pulse representing the start of a "ping".

5. Evaluative Trials

Development tests of the DSG instrumentation and bench test procedures were carried out on two SIDA systems which were known to be fully functional. A subsequent trial was conducted using the SIDA system located at HMAS Lonsdale. This system had previously been used for playback of prerecorded sonar data but had never been used to record raw sonar data. Upon connection of the DSG, however, it was found that the SIDA would not trigger and, furthermore, the trigger circuit LED on the DSG indicated a possible short-circuit in the SIDA. The fault was not rectified by replacing the interconnecting cable, so the trigger sub-module was suspected to be faulty (see Table 1) and the maintenance engineers were called in. The problem was subsequently confirmed as being due to a short-circuit in an internal connector leading to that sub-module.

6. Discussion and Conclusion

The procedures which have been described in this report were developed as a result of a series of experiments conducted by the authors and involving the route surveillance system. In devising the methods, due regard was given to the short tenure which is normally associated with junior-level naval postings. The methods and instrumentation which have been devised were therefore kept as simple as possible so that they could be quickly mastered.

The DSG test hardware fulfilled all design criteria laid down in section 4.1. A distinctive and repeatable signal which can be traced through the SIDA system was obtained. Hence, correct operation of the SIDA system can be determined independent of the side scan sonar unit. Correct calibration of the analogue-to-digital converters in the SIDA system, or alternatively the Klein 595 chart recorder, can be confirmed with the aid of the built-in, adjustable DC generator. The timing and synchronisation pulses generated by the DSG proved to be indistinguishable from those of the Klein unit with an output voltage within A/D converter limitations. A low power consumption for battery operation was achieved and the circuitry (including batteries) was housed in an appropriately small box to ensure portability. The DSG was tested to determine its maximum battery life for reliability under continuous operation at maximum load (all LED's set to ON). It was found that an operational battery life of at least five hours could be achieved.

It is recommended that a set of performance standards be established for the SIDA digitisers, and that the calibration of these be checked as part of a regular maintenance schedule.

7. References

1. *Sonar imaging and data acquisition system operations guide for the Royal Australian Navy* (Prerelease Manual 1.1) (1991). Info Express Inc, Kirkland, USA.

2. MSP letter N85/26939(36) Phase 2A IMFOR ASC issued 25 July 1990.

3. Klein Digital Sonar System 590, Klein Associates Inc, Salem, USA, 1987.

Appendix 1

Acronyms

A/D	Analog to Digital Converter
ASC	Agreed Ship Characteristics
DAM	Data Acquisition Module
DSG	Diagnostic Signal Generator
DVM	Digital Volt Meter
IPVD	Image Processing and Video Display module
LED	Light Emitting Diode
MSA	Minesweeping Auxiliary
MSP	Minesweeping Project
RSS	Route Surveillance System
SCR	Silicon Controlled Rectifier
SIDA	Sonar Imaging and Data Acquisition System

Appendix 2

DSG Hardware Implementation

Circuit Description

The DSG circuit schematic (Fig. A1) has been split into the four functional stages described above. The LM 317 adjustable 3-terminal positive voltage regulator (U1) was selected to provide the required voltage regulation because its ability to provide a suitable output current with both line and load regulation is superior to that of many fixed regulators. If the regulator output voltage exceeds 5.5 V, the zener voltage of D2 is exceeded, and Q1 will be turned ON via R39. With Q1 ON, sufficient current will pass through R3 to turn ON the SCR (Q11), thus causing a short circuit across the fuse (F1). Thus, fuse F1 will be caused to blow if the supply voltage exceeds 5.5 V at U1. This circuit provides good over-voltage protection for the DSG and more importantly, prevents possible damage to the SIDA unit should a voltage regulator failure occur.

The LM 3905 precision timer (U5) is configured for astable operation with an operating frequency of approximately 7 Hz (see Fig. 2). An operating frequency of 7 Hz was selected to correspond with the sampling period of side scan sonar operating in mapping mode at 100 m range and with a towfish altitude up to 40 m (Ref. 3, section 4.6). The resulting waveform serves as an input to following stages (see timing waveforms at Figure A1), thus providing an accurate clocking for subsequent timing waveforms.

In the third stage, the SN 74221 dual monostable multivibrator (U6) generates the control signals which determine the relative durations of the two side scan sonar stages (Fig. 2). The LM 3900 operational amplifier (U2C) is configured to yield a "RAMP DOWN" output waveform. With the addition of an analogue switch (U4) the STEADY STATE HIGH component of the waveform can be removed while still maintaining a fast rising edge. In addition to the ramp waveform, a simple DC generator (output of Q4) is used to provide an adjustable, constant voltage to confirm the calibration of the analogue-to-digital converters in the SIDA system. A ten-turn potentiometer (R13) is used to achieve fine control of the output voltage setting. The driver transistors for the LED status indicators are driven directly off the outputs of the DSG. Thus the LEDs give a visual indication of the actual output of the unit. Any abnormality in the output of the DSG, caused by connection to a defective cable or SIDA channel, will be reflected in an abnormality in the output of the LEDs. Finally the circuit is configured so that, at any time, separate sonar output can be switched between the two operating modes, or switched off completely, independent of the other outputs. A signal can therefore be input to any channel which is different rom the signal at the others, enabling a simple test to be made that each channel has been correctly connected.

The Synchronous Pulse Generator stage is based on a SN 74121 monostable multivibrator (U3). This device provides the synchronous pulses required to drive the SIDA or Klein units, each pulse representing the start of a "ping".

Power Requirements and Operating Conditions

The DSG uses six "AA" size batteries to provide a nominal 9 V supply. The
minimum input voltage required by the LM 317 voltage regulator to maintain an
output voltage of 5 V continuous is 7.8 V. A maximum current of about 100 mA
is required to power the DSG with all the LED's ON. In this case, alkaline
batteries are recommended as these typically have a capacity of at least
1500 mA-hr, thus providing for several hours of continuous operation.
Alternatively, external DC operation is possible with most DC mini-power
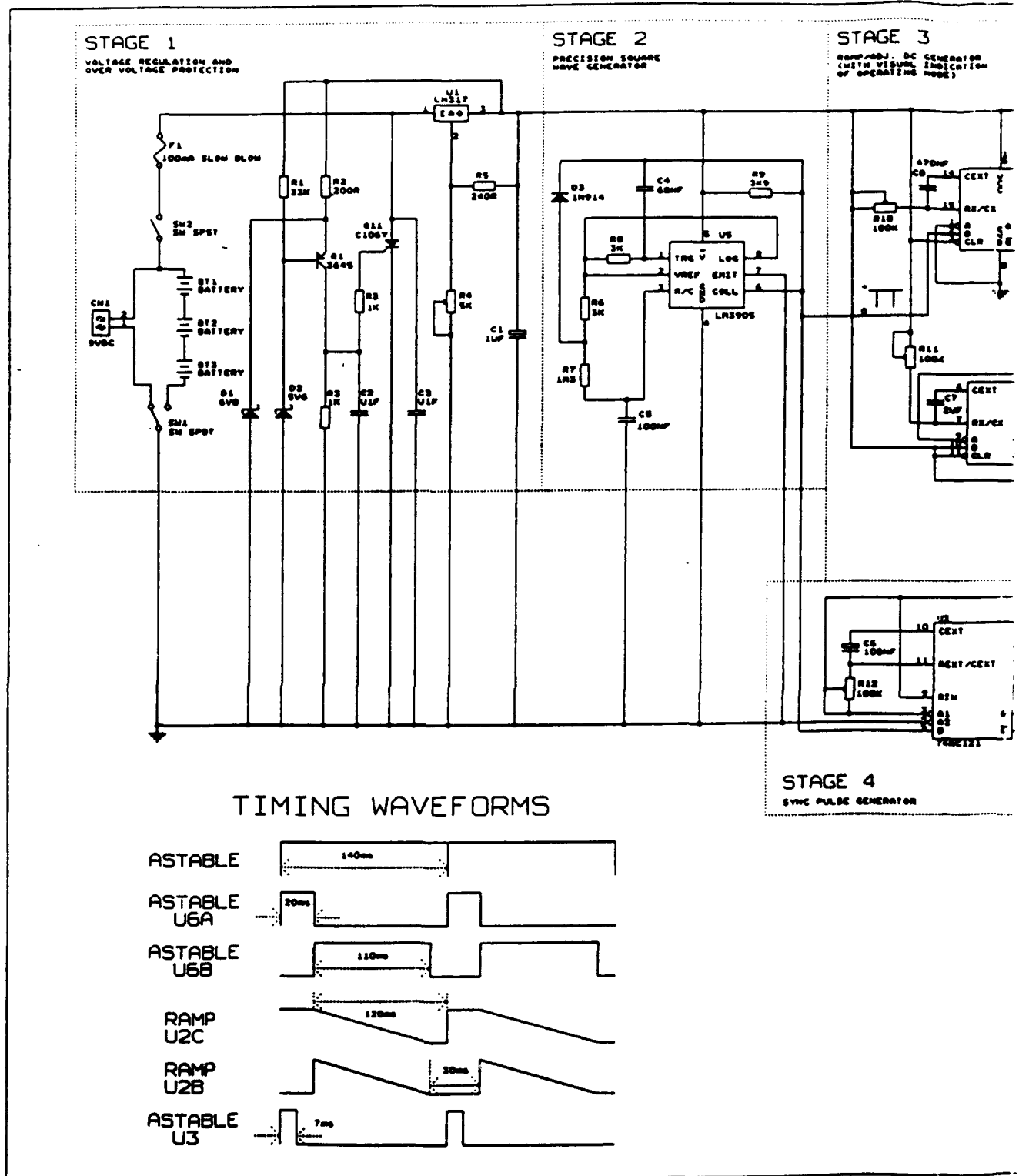supplies which are externally switchable in the range 9 to 12 V.

Figure A1: Circuit schematic and timing diagrams for the DSG instrument.

STAGE 3

Ramp/Adj. DC Generator
(with visual indication
of operating mode)

STAGE 4

Sync Pulse Generator

MATERIALS RESEARCH LABORATORY
Title
SYNTHETIC SONAR OUTPUT SIGNAL GENERATOR
24/494118/49200

Diagnostic Procedures for the Royal Australian Navy
Side Scan Sonar Display

B.C. Pamias and R.A. Neill

(MRL-TN-629)

DISTRIBUTION LIST

Director, MRL
Chief, Maritime Operations Division
Dr D. Richardson
B.C. Pamias
R.A. Neill
MRL Information Services

Chief Defence Scientist (for CDS, FASSP, ASSCM)   1 copy only
Director (for Library), Aeronautical Research Laboratory
Head, Information Centre, Defence Intelligence Organisation
OIC Technical Reports Centre, Defence Central Library
Officer in Charge, Document Exchange Centre   8 copies
Army Scientific Adviser, Russell Offices - DCDS only
Air Force Scientific Adviser, Russell Offices
Navy Scientific Adviser
Scientific Adviser, Defence Central
Director General Force Development (Land)
Senior Librarian, Main Library DSTOS
Librarian - MRL Sydney
Librarian, H Block
DASD, APW2-1-OA2
ABCA, Russell Offices
Librarian, Australian Defence Force Academy
NAPOC QWG Engineer NBCD c/- DENGRS-A, HQ Engineer Centre, Liverpool
    Military Area, NSW 2174
Counsellor, Defence Science, Embassy of Australia - data sheet only
Counsellor, Defence Science, Australian High Commission - data sheet only
Scientific Adviser to DSTC Malaysia, c/- Defence Adviser - data sheet only
Scientific Adviser to MRDC Thailand, c/- Defence Attache - data sheet only
Head of Staff, British Defence Research and Supply Staff (Australia)
NASA Senior Scientific Representative in Australia
INSPEC: Acquisitions Section Institution of Electrical Engineers
Head Librarian, Australian Nuclear Science and Technology Organisation
Senior Librarian, Hargrave Library, Monash University
Library - Exchange Desk, National Institute of Standards and Technology, US
Exchange Section, British Library Document Supply Centre
Periodicals Recording Section, Science Reference and Information Service, UK
Library, Chemical Abstracts Reference Service
Engineering Societies Library, US
Documents Librarian, The Center for Research Libraries, US

MSPD
Martin Lawrence, MOD-Sydney
COMAUSMINFOR

REPORT NO. MRL-TN-629	AR NO. AR-008-240	REPORT SECURITY CLASSIFICATION Unclassified

TITLE

Diagnostic procedure for the Royal Australian Navy side scan sonar display

AUTHOR(S) B.C. Pamias and R.A. Neill	CORPORATE AUTHOR DSTO Materials Research Laboratory PO Box 50 Ascot Vale Victoria 3032

REPORT DATE September, 1993	TASK NO. DST 88/157	SPONSOR DSTO

FILE NO. G6/4/8-4134	REFERENCES 3	PAGES 21

CLASSIFICATION/LIMITATION REVIEW DATE	CLASSIFICATION/RELEASE AUTHORITY Chief, Maritime Operations Division

SECONDARY DISTRIBUTION

Approved for public release

ANNOUNCEMENT

Announcement of this report is unlimited

KEYWORDS

SIDA	Diagnostic Signal Generator	Sonar Data Acquisition

ABSTRACT

The report describes bench testing and fault finding methodologies and instrumentation which are intended for use with the sonar data acquisition and display component of the Royal Australian Navy route surveillance system. The proposed techniques are to be used operationally at the organisational and intermediate levels. Test hardware is described which provides acceptable test signals for the evaluation and fault finding analysis of the Info Express Sonar Imaging and Data Acquisition (SIDA) system and, in part, the Klein 595 Side Scan Sonar units, including all associated A/D converters. This equipment has been used successfully in locating a previously unsuspected fault in one SIDA unit. A recommendation is made that standards be established against which the performance of the SIDA unit's digitisers can be assessed.